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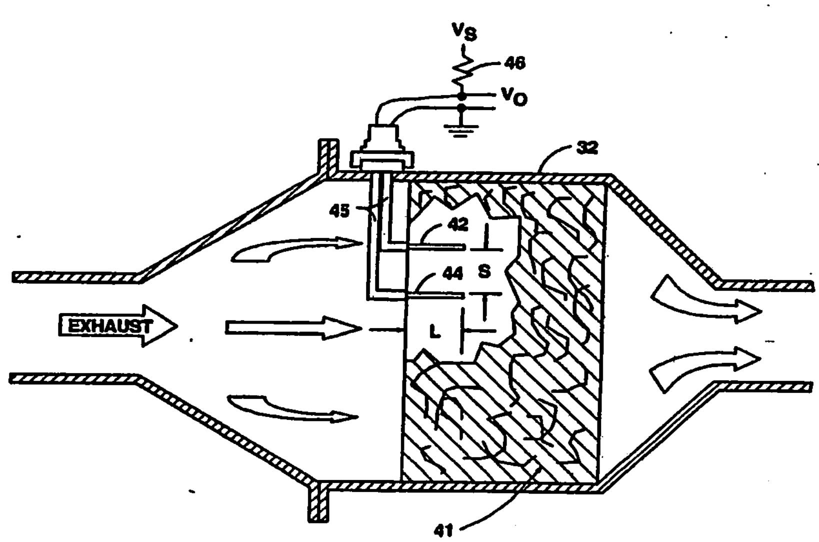
(54) Title: METHOD AND APPARATUS FOR INITIATING REGENERATION IN AN ENGINE EXHAUST PARTICULATE FILTER



(57) Abstract

A sensor is disclosed for detecting the level of particle accumulation in a particulate filter (32) having a filter material (41) effective to extract particulates from the exhaust gas flow of an internal combustion engine (12). The sensor includes at least two electrodes (42, 44) extending into the filter material (41) and being spaced apart by a preselected distance (S) and a circuit for producing an electrical signal which is responsive to the electrical resistance between the electrodes (42, 44) whereby the measured resistance is responsive to the level of particulate accumulation in the filter (32).

Description

Method and Apparatus for Initiating Regeneration In an Engine Exhaust Particulate Filter

Technical Field

This invention relates generally to the technology of regenerating a particulate filter for the exhaust gases of an internal combustion engine and, more specifically, to a method and apparatus for more effectively detecting soot accumulation in a particulate filter.

Background Art

Federal and state governments have adopted stringent standards for emissions for all diesel powered road vehicles. A common strategy used to meet these standards involves the use of particulate trap filters located in the engine exhaust stream for removing contaminates, and in particular carbon and hydrocarbon particles, from the exhaust gases of an internal combustion engine. Generally, durable and acceptable particulate filters have been developed in the past. Such filters have included wire mesh (see U.S. Pat. No. 3,499,269) and, more recently, rigid ceramics in the form of a honeycomb monolithic cellular wall structure and other similar constructions, see e.g. U.S. Pat. Nos. 4,276,071; 4,329,162; and 4,340,430.

However, with continued use the particles begin to fill the filter and restrict exhaust gas flow. As should be apparent, restriction of exhaust gas flow can adversely affect engine performance and fuel economy. Hence, systems have been developed to

periodically clean the particles from the filter. This process is generally referred to as regeneration. Several different regeneration strategies have been developed and most fit into one of the following classifications: electrical heating, hydrocarbon fuel fed burners, catalyst impregnated filters, engine throttling and backpressure controls.

In the past, regeneration has typically been manually triggered by the operator or initiated at a fixed time interval. Manually triggered regeneration can, of course, lead to inadequate or excessive regeneration temperatures due to the operator's failure to initiate the regeneration system at the correct time. Similarly problems can result in a system which initiates the regeneration process at a fixed time interval.

More recently automated regeneration systems have been developed which utilize microprocessors to monitor sensed parameters and activate the regeneration process in response to the sensed parameters. A common initiation strategy involves detecting filter clogging by measuring a pressure differential across the filter. One such system is disclosed in U.S. Pat. No. 4,538,411 which issued on September 3, 1985, to Wallace et al. Wallace et al. discloses a system which senses an actual pressure drop across a particulate filter and senses a pressure drop across an open channel simulative filter structure. The two pressure drops are converted to proportional voltages and regeneration is initiated when a ratio of the sensed pressure drops exceeds a preselected limit. However, systems which measure the filter pressure drop suffer from several disadvantages. Specifically, the pressure sensors utilized are subject to inaccuracies due to clogging

caused by the particulates and condensation of the exhaust gases. Moreover, because the measured pressure differential is small, typically on the order of 2 to 5 psi, a sensitive and hence expensive pressure sensor is required. Additionally, because the sensed pressure differential is a function of air flow rate, the system must compensate for engine speed and load operating conditions. This requires additional sensors and controls which add cost and complexity to the overall regeneration control.

Along a different line, U.S. Pat. No. 4,829,766 which issued on May 16, 1989, to Henkel, discloses a regeneration system which eliminates the need for pressure sensors. This is accomplished by providing an electrode configuration in the form of electrode coils, electrode grids or plates of high heat-resistance material disposed through the particulate filter. The electrodes are continuously energized with a voltage potential from an impressed power source. Localized regenerations occur between the plates as particulates accumulate between the energized electrodes and create a current path. However, because the regeneration only occurs at the point of highest conductance (i.e., greatest particle concentration), a substantial portion of the filter could still be clogged. Moreover, the filter could be in a nearly constant state of regeneration, resulting in decreased operating efficiency of the filter. Additionally, because this system draw power continuously, the overall efficiency of the system is decreased.

The present invention is directed to overcoming one or more of the problems set forth above by providing a low cost device for initiating and culminating the regeneration process. The present

invention is advantageous because it can be adapted for use with a variety of commercially available regeneration controls and particulate filters with only minimal modifications and it is independent of engine operating conditions.

Disclosure of the Invention

A sensor is disclosed for detecting the level of particle accumulation in a a particulate filter 32 having a filter material 41 effective to extract particulates from the exhaust gas flow of an internal combustion engine 12. The sensor includes at least two electrodes extending into the filter material and being spaced apart by a preselected distance and a circuit for producing an electrical signal which is responsive to the electrical resistance between the electrode, whereby the measured resistance is responsive to the level of particulate accumulation in the filter.

Also disclosed is an apparatus is provided for activating a particulate filter regeneration system 10 which includes a particulate filter 32 having a filter material 41 effective to extract particulates from the exhaust gas flow of an internal combustion engine 12. A sensor means 40 is disposed in the particulate filter for sensing the electrical resistance between at least two points in the filter material 41 and producing an output signal responsive to the sensed resistance. A controller is provided 38 for receiving the output signal, comparing the output signal to a first preselected threshold, and initiating a regeneration process in response to the signal falling below the first preselected threshold. Alternatively, the sensor 40 can be adapted to produce an output responsive to the sensed conductance between

two points in the filter. The controller 38 can be programmed to initiate a regeneration in response to the sensor output signal rising above a first preselected threshold.

Brief Description of the Drawings

Fig. 1 is a schematic view of an engine and exhaust gas particulate filter regeneration system which incorporates the present invention;

Fig. 2 is a cross-sectional view of a particulate filter incorporating the present invention;

Fig. 3 is a graph illustrating the general relationship between sensed electrical resistance and filter clogging;

Fig. 4 is a graph illustrating the relationship between sensed electrical resistance and filter clogging for an optimized implementation of the present invention;

Fig. 5 is a graph illustrating the general relationship between filter temperature and sensed electrical resistance;

Fig. 6a is a schematic illustration of a second embodiment of the present invention; and

Fig. 6b is an electrical representation of the second embodiment of the present invention.

Best Mode for Carrying Out the Invention

Referring now to the drawings, the present invention will be described in connection with a regeneration control which uses exhaust backpressuring to incinerate the particulates which accumulate in a particulate trap filter. One such control is disclosed in U.S. Pat. No. 4,835,963, hereinafter referred to a '963, which issued on June 6, 1989, to

Hardy and is specifically incorporated by reference herein. In '963, as in many past systems, the regeneration process is initiated in response to a sensed pressure drop across the particulate filter. This pressure drop is detected using an air pressure sensor located in the engine exhaust. As set forth above, elimination of such sensors is desirable because the sensors are subject to malfunctions due to clogging, for example. The present invention is directed towards an apparatus which senses the degree of filter clogging, without the use of pressure sensors, and responsively produces an output signal which can be used to initiate and culminate the regeneration process. It should be noted that the exact regeneration control forms no part of the present invention and that the present invention is equally applicable to other regeneration controls such those set forth above in the "background" section.

In Fig. 1 an engine particulate filter system 10 is shown for use with an engine 12, such as a diesel powered internal combustion engine having a plurality of combustion cylinders (not shown) for rotatably driving an engine crankshaft (not shown). While shown to be used with a turbocharger 20, the regeneration system 10 can be used with a naturally aspirated engine. The engine 12 includes an air intake manifold 16 through which air is supplied by means of a compressor 18 of the turbocharger 20. In operation, the compressor 18 draws ambient air through an air filter 22 and compresses the air with a rotatable compressor impeller (not shown) to form so-called charge air for supply to the engine via the inlet manifold 16.

Exhaust products are discharged from the engine 12 through an exhaust manifold 28 for supply to

a turbine 24 of the turbocharger 20. The high temperature exhaust gas rotatably drives a turbine wheel (not shown) at a relatively high rotational speed (up to 190,000 RPM) to correspondingly drive the compressor impeller (not shown) within the compressor housing 18. After driving communication with the turbine wheel, the exhaust gases are discharged from the turbocharger 20 through an exhaust gas outlet 30.

The regeneration system 10 includes an exhaust particulate filter 32 connected to the turbocharger exhaust gas outlet 30. The regeneration system 10 further includes a backpressure valve 34 located between the exhaust gas outlet 30 and the particulate filter 32. An actuator 36 is provided for controlling movement of the backpressure valve 34 in response to an actuator control signal as produced by a controller means 38.

The particulate filter 32 can be made of any suitable material or configuration capable of trapping and holding suitable quantities of particulates from the engine exhaust gas stream without creating an excessive restriction to the exhaust gas flow. The filter 32 must also be able to withstand the elevated temperatures required during regeneration. When used with a turbocharged engine, the particulate filter 32 should be located as close downstream of the turbocharger as possible in order that the exhaust gas retain its high temperature. The particulate filter 32 should also have as low a pressure drop as possible in order to minimize the effect on engine performance.

The backpressure valve 34 can be any type of valve, such as a butterfly valve, which provides control over the exhaust gas flow area. The backpressure valve 34 will not be described in greater detail herein. A suitable backpressure valve 34 is

described in '963, and reference is directed to that disclosure for further detail. The actuator 36 is adapted to receive an electrical actuator control signal from the controller means 38 and responsively control the position of the backpressure valve 34. Actuators of this type are well known in the art and will not be described in greater detail herein.

The controller means 38 is connected to a plurality sensors through conventional conditioning circuits for receiving respective input signals, as described in '963. The controller means 38 processes these signals and delivers an actuator control signal to the actuator 34 to control the actuator position in accordance with the desired backpressure regulatory strategy. Attention is directed to the disclosure of '963 for a more detailed description of a suitable regulatory strategy. The controller means 38 is preferably implemented employing a microprocessor having external RAM and ROM (not shown) and being programmed to control operation of the actuator 34 in response to the input signals. A number of commercially available devices are adequate to perform the control functions of the controller means 38, as would be known to one skilled in the art.

A sensor means 40 is provided for sensing when the particulate filter 32 needs regeneration and responsively producing an output signal. In a first embodiment, shown in Fig. 2, the sensor means 40 includes first and second electrodes 42,44 disposed in the particulate filter 32 in the area of particulate accumulation. In Fig. 2, the filter 32 has a fibrous filter material 41. The electrodes 42, 44 extend into the filter material 41 for sensing particulate accumulation in the filter material, as explained below. Preferably, the electrodes are electrically

insulate from each other up to the point where they extend into the filter medium 41. This is accomplished using ceramic fiber sleeves 45 which surround the individual electrodes 42,44. The materials used for the electrodes 42,44 must be electrically conductive, have melting point in excess of the temperature of regeneration and be oxidization resistant. Two commercially available allows have been identified which are suitable for forming the electrodes. The first is an alloy consisting of approximately 22% Chromium, approximately 5.8% Aluminum, and approximately 72.2% Iron. An alloy of this composition is available from the Kanthal Corporation as Kanthal Alloy #A1. A second suitable allow consists of approximately 16% Chromium, approximately 4.5% Aluminum, less than 0.5% Yitruim, approximately 2.5% Iron, and the balance of material being Nickel. An alloy of this composition is available from Haynes International, Inc. as Haynes Alloy #214. It should be noted that numerous other materials could be used to form the electrodes 42,44 and the invention is not limited to electrodes formed from the above-identified alloys.

The controller means 38 is connected to the electrodes 42,44 and is adapted to sense the level of resistance between the electrodes 42,44. More specifically, the a first electrode 42 is connected to a preselected voltage V_S through a pull-up resistor 46. The second electrode 44 is connected to system ground. It should be apparent that the second electrode could be connected to a second reference voltage, as opposed to system ground. The controller means 38 has an input terminal 48 connected to the junction of the pull-up resistor 46 and the first electrode 42, and being adapted to sense a voltage

potential V_O present at the junction. Hence the voltage potential V_O sensed by the controller means 38 is directly proportional to the resistance between the electrodes 42,44. As soot, in the form of conductive carbon and hydrocarbon particles, begins to accumulate in the particulate filter medium 41, the resistance and hence the sensed voltage V_O decreases, as illustrated in Fig. 3. Fig. 3 is a graph illustrating the general relationship between sensed electrical resistance and filter clogging. The controller means 38 is programmed to compare the sensed voltage V_O to a first empirically determined threshold and initiate the regeneration process when the sensed voltage V_O falls below the first threshold T1.

Alternatively, the conductance between the first and second electrodes 42,44 could be sensed by the controller means 38. If conductance were sensed, the measured conductance would increase with particle accumulation. The controller means 38 could be programmed to initiate regeneration when the measured conductance exceeded an empirically determined threshold.

Placement of the electrodes 42, 44, electrode size L, and electrode spacing S must all be empirically determined in accordance with the specific filter configuration being utilized. By optimizing electrode placement, electrode size L and electrode spacing S, the curve of Fig. 3 can be shifted so that regeneration is not initiated until the filter 32 reaches 100 percent capacity.

Preferably, the controller means 38 continues the regeneration process until the sensed resistance rises above a second predetermined threshold T2 which is greater than the first predetermined threshold T1 and sufficient to ensure

complete regeneration. However, it is foreseeable that output from the sensor means 40 could be utilized to initiate a regeneration which continues for a preselected time interval. Conversely, if conductance is sensed, regeneration is continued for until the sensed conductance falls below an empirically determined threshold.

A temperature sensor 50 is provided for sensing the temperature of the exhaust gasses passing through the filter 32 and responsively producing a temperature signal which is delivered to the controller means 38. Numerous types of temperature sensors are adequate to perform this function; hence, the temperature sensor 50 will not be explained in greater detail. The controller means 38 is programmed to modify the input voltage V_O to compensate for the effects of temperature on the sensed resistance. The effects of temperature on resistance are generally illustrated in Fig. 5; however, the exact relationship must be determined a given combination filter configuration.

Referring now to Figs. 6A and 6B, a second embodiment of the present invention will be briefly discussed. In the second embodiment, the sensor means 40 includes an electrode grid network 58 which is embedded within the filter. The grid network consists of electrodes 60 laid out in both serial and parallel fashion. Electrically, the grid network 58 can be represented as illustrated in Fig. 6B. The grid network is connected between a preselected voltage potential V_S and system ground. A pull-up resistor 46 is connected between the grid network 58 and the preselected voltage potential V_S. The controller means 38 has an input terminal 48 connected to the junction of the pull-up resistor 46 and the grid

network 58, and being adapted to sense a voltage potential V_O present at the junction. Hence the voltage potential V_O sensed by the controller means 38 is directly proportional to the resistance across the grid network 58. As the conductive carbon and hydrocarbon particles begin to accumulate in the particulate filter 32, the resistance and hence the sensed voltage V_O decreases.

The grid network 58 of the second embodiment is advantageous over a sensor having only two electrodes because it gives a more representative measure of filter clogging by sensing particulate deposits throughout the entire filter 38. However, the manufacturing costs associated with the grid network 58 could be excessive in many applications. Moreover, the design of the first embodiment is adequate for most applications.

Industrial Applicability

The present invention is useful for initiating and culminating operation of a regeneration system 10 for an internal combustion engine 12, such as a diesel engine. During operation of the engine 12, exhaust gasses are discharged through the particulate filter 32. The particulate filter 32 functions to remove contaminates, and in particular carbon and hydrocarbon particles, from the exhaust gases. The present invention is in the form of a sensor means 40 having electrodes 42,44 disposed in the filter material for sensing particle accumulation. The electrodes 42,44 are connected between a preselected voltage potential V_S and system ground or second reference voltage. As the particles accumulate between the electrodes 42,44, the electrical resistance between the electrodes 42,44 decreases.

The controller 38 is adapted to sense a voltage V_O which is proportional to the resistance across the electrodes 42,44 and initiate regeneration when the sensed voltage V_O falls below a first empirically determined threshold. The controller means 38 can be programmed to continue regeneration for a preselected time period or until the sensed voltage rises above a second empirically determined threshold which is sufficient to ensure complete filter regeneration.

Claims

1. A sensor for detecting the level of particle accumulation in a a particulate filter (32) having a filter material (41) effective to extract particulates from the exhaust gas flow of an internal combustion engine (12), comprising:

at least two electrodes extending into the filter material and being spaced apart by a preselected distance,

means for producing an electrical signal which is responsive to the electrical resistance between the electrode, whereby the measured resistance is responsive to the level of particulate accumulation in the filter.

2. An apparatus for activating a particulate filter regeneration system (10) including a particulate filter (32) having a filter material (41) effective to extract particulates from the exhaust gas flow of an internal combustion engine (12), comprising:

a sensor means (40) disposed in the filter material (41) for sensing an electrical resistance between at least two point in the filter material (41) and producing an output signal responsive to the sensed resistance;

controller means (38) for receiving the sensor output signal, comparing the sensor output signal to a first preselected threshold, and initiating filter regeneration in response to the signal falling below the first preselected threshold.

3. An apparatus as set forth in claim 2 wherein the sensor means (40) includes at least two

electrodes (42,44) disposed in filter (32) wherein the sensor means produces an output signal responsive to the electrical resistance between the electrodes (42,44).

4. An apparatus as set forth in claim 2 further including a temperature sensor (50) disposed in the engine exhaust path for sensing the exhaust gas temperature and responsively producing a temperature signal and wherein said controller means (38) receives the temperature signal and responsively modifies the sensor output signal in a manner to correct for temperature changes on the sensed resistance.

5. An apparatus as set forth in claim 2 wherein regeneration continues for a preselected time period.

6. An apparatus as set forth in claim 2 wherein regeneration continues until the output signal rises above a second threshold which is greater than the first threshold and sufficient to ensure complete filter regeneration.

7. An apparatus as set forth in claim 2 wherein the sensor means (40) includes an electrode grid network (58) having a plurality of electrodes (60) disposed in the filter material (41).

8. An apparatus as set forth in claim 2 wherein the controller means (38) is further operative for comparing the sensor output signal to a second preselected threshold which is higher than the first preselected threshold, and terminating filter

regeneration in response to the signal falling below the second preselected threshold.

9. An apparatus for activating a particulate filter regeneration system (10) including a particulate filter (32) having a filter material (41) effective to extract particulates from the exhaust gas flow of an internal combustion engine (12), comprising:

a sensor means (40) disposed in the filter material (41) for sensing an electrical conductance between at least two points in the filter material (41) and producing an output signal responsive to the sensed conductance;

controller means (38) for receiving the output signal, comparing the output signal to a first preselected threshold, and initiating filter regeneration in response to the signal exceeding the first preselected threshold.

10. An apparatus as set forth in claim 9 wherein the sensor means (40) includes at least two electrodes (42,44) disposed in filter material (32) wherein the sensor means (40) produces an output signal responsive to the electrical conductance between the electrodes (42,44).

11. An apparatus as set forth in claim 9 further including a temperature sensor (50) disposed in the engine exhaust path and adapted to sense the exhaust gas temperature and responsively produce a temperature signal and wherein the controller means (38) receives the temperature signal and responsively modifies the sensor output signal in a manner to

correct for effects temperature changes on the sensed conductance.

12. An apparatus as set forth in claim 9 wherein regeneration continues for a preselected time period.

13. An apparatus as set forth in claim 9 wherein regeneration continues until the output signal falls below a second threshold which is greater than the first threshold and sufficient to ensure complete filter regeneration.

14. An apparatus as set forth in claim 9 wherein the sensor means (40) includes an electrode grid network (58) having a plurality of electrodes disposed in the filter (32).

15. An apparatus as set forth in claim 10 wherein the controller means (38) is further operative for comparing the sensor output signal to a second preselected threshold which is lower than the first preselected threshold, and terminating filter regeneration in response to the signal falling below the second preselected threshold.

16. A method for activating a particulate filter regeneration system (10) including a particulate filter (32) having a filter material (41) effective to extract particulates from the exhaust gas flow of an internal combustion engine (12) and a controller means (38) for controlling filter regeneration, including the steps of:

sensing an electrical resistance between two points in the filter material (41) and producing an output signal responsive to the sensed resistance;

programming the controller means (38) to receive the sensor output signal, compare the output signal to a preselected threshold, and initiate filter regeneration in response to the output signal falling below the preselected threshold.

17. An apparatus as set forth in claim 16 including the step of programming the controller means (38) to compare the output signal to a second preselected threshold which is greater than the first preselected threshold, and to terminate filter regeneration in response to the signal exceeding the second preselected threshold.

18. A method for activating a particulate filter regeneration system (10) including a particulate filter (32) having a filter material 17 effective to extract particulates from the exhaust gas flow of an internal combustion engine (12) and a controller means (38) for controlling filter regeneration, including the steps of:

sensing an electrical conductance between two points in the filter material (41) and producing an output signal responsive to the sensed conductance;

programming the controller means (38) to receive the output signal, compare the output signal to a preselected threshold, and initiate filter regeneration in response to the output signal exceeding the preselected threshold.

19. An apparatus as set forth in claim 18 including the step of programming the controller means

(38) to compare the sensor output signal to a second preselected threshold which is less than the first preselected threshold, and to terminate filter regeneration in response to the signal falling below the second preselected threshold.

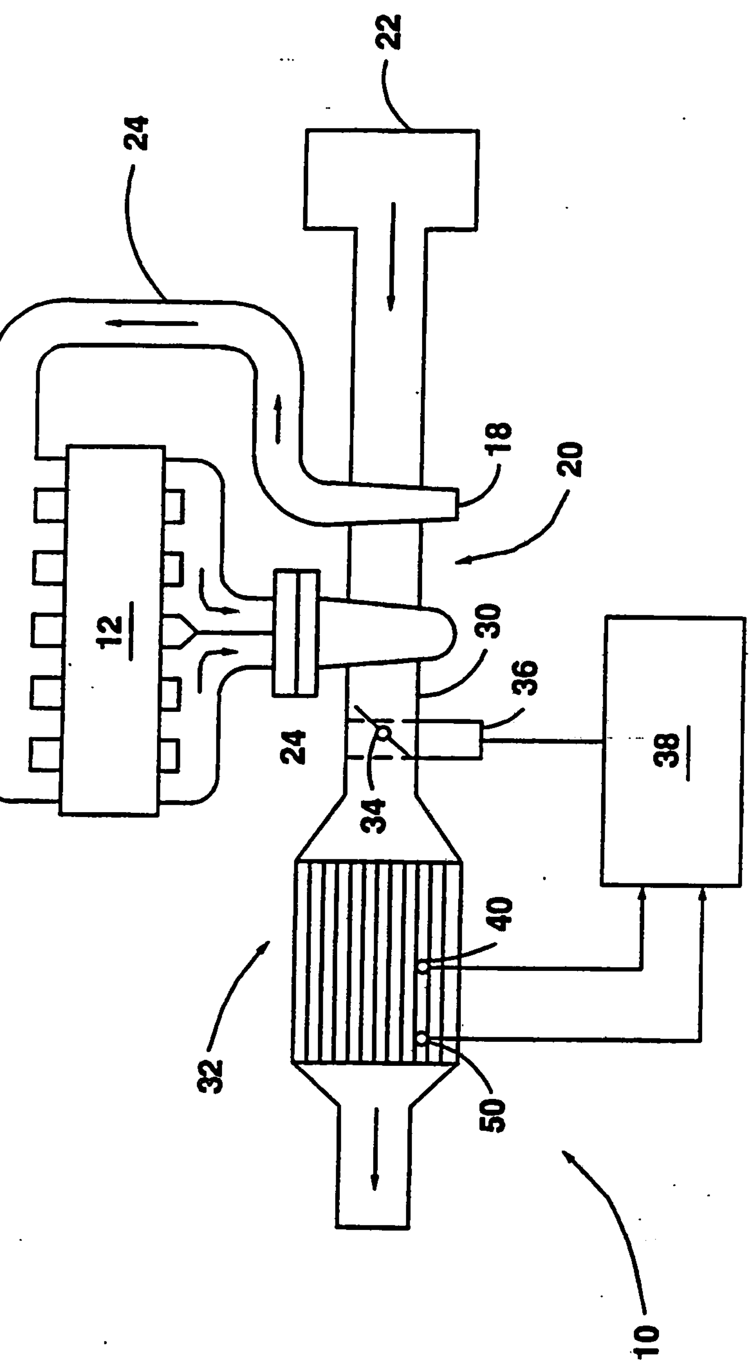


Fig. 1

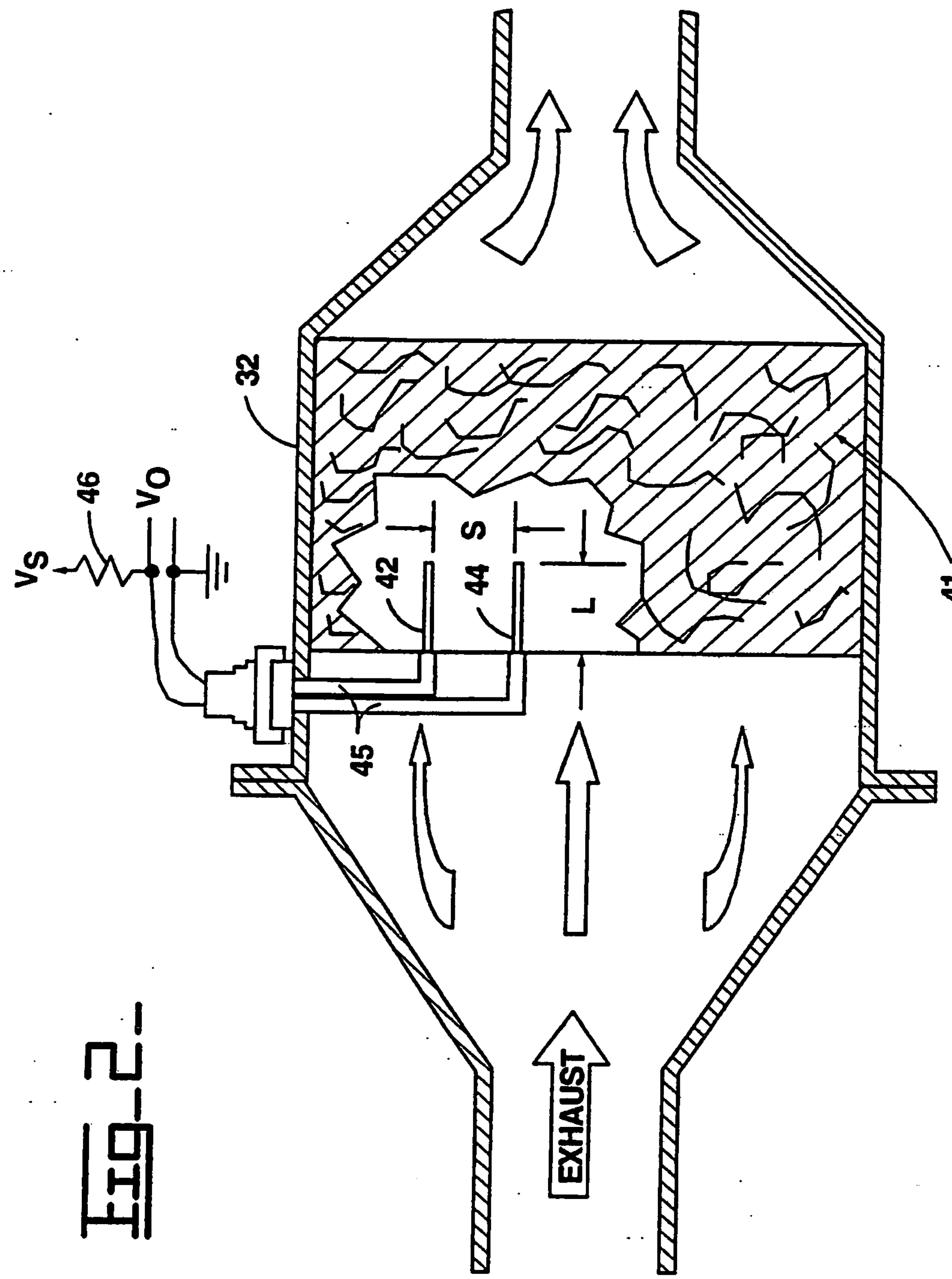


Fig_2_

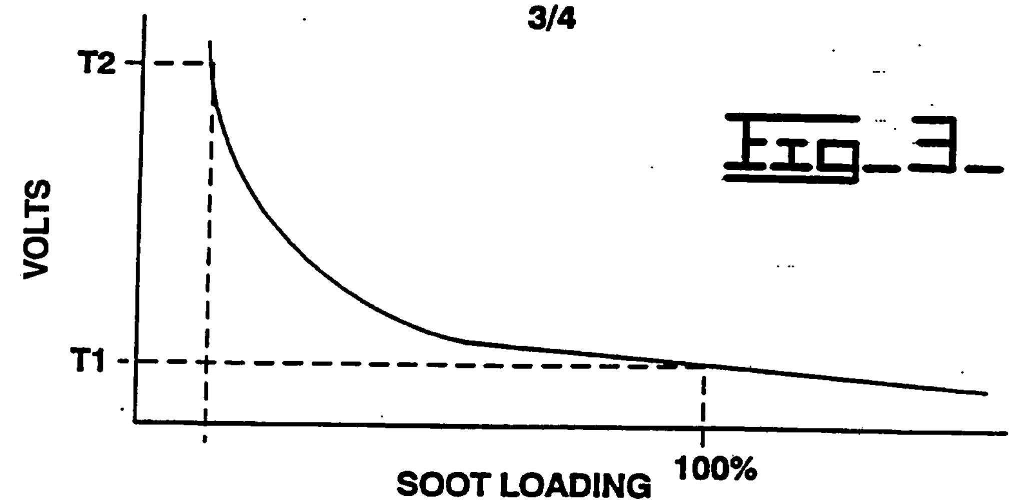


Fig. 3

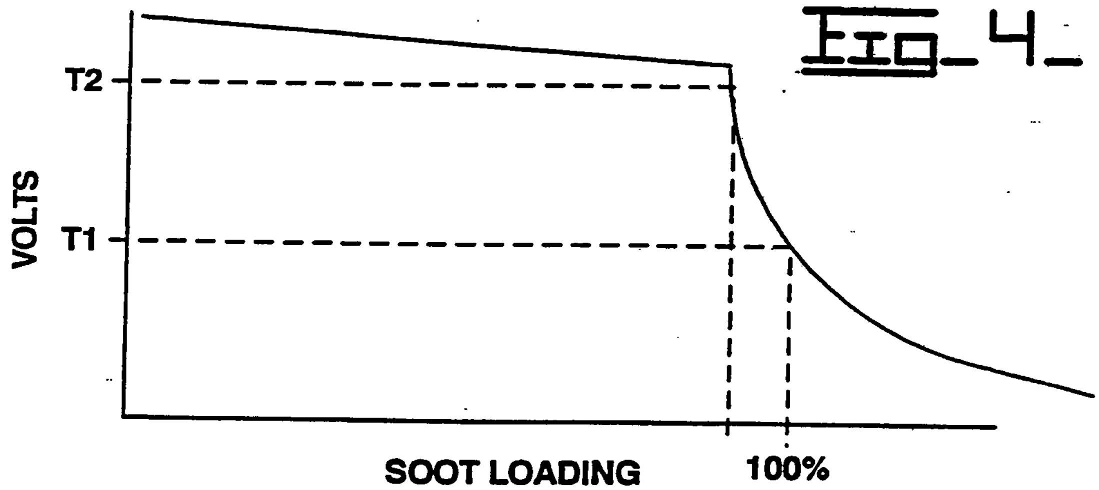


Fig. 4

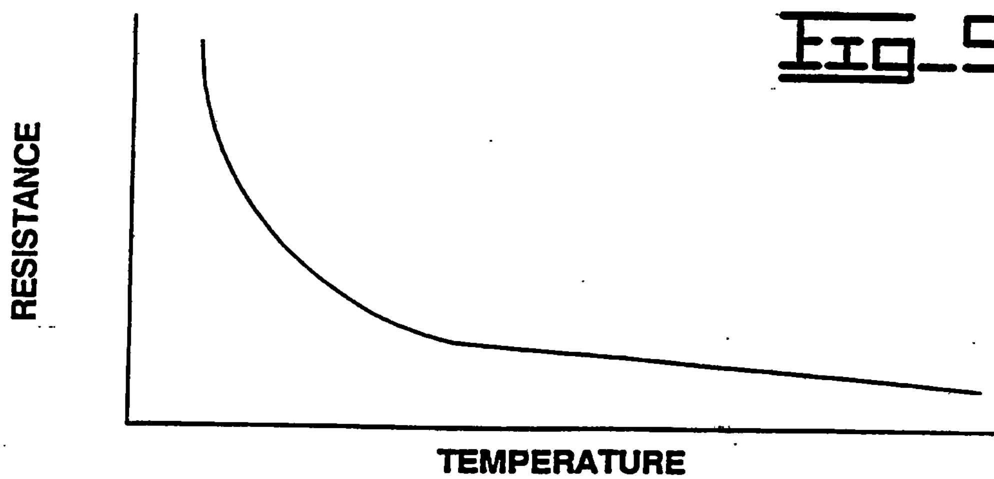
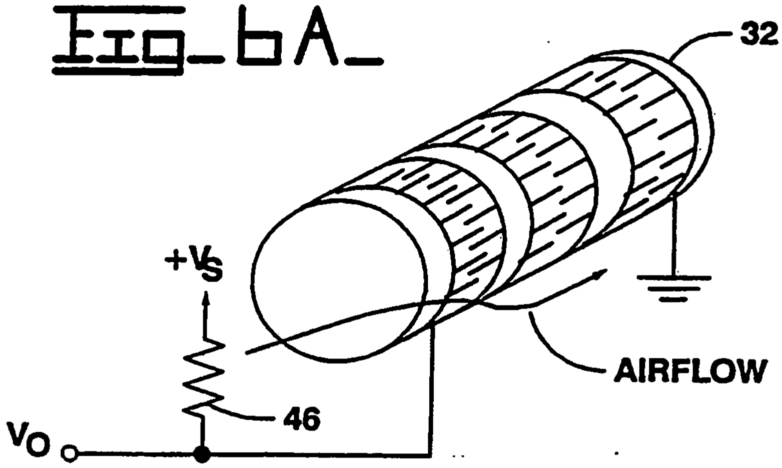


Fig. 5

FIG. 6A



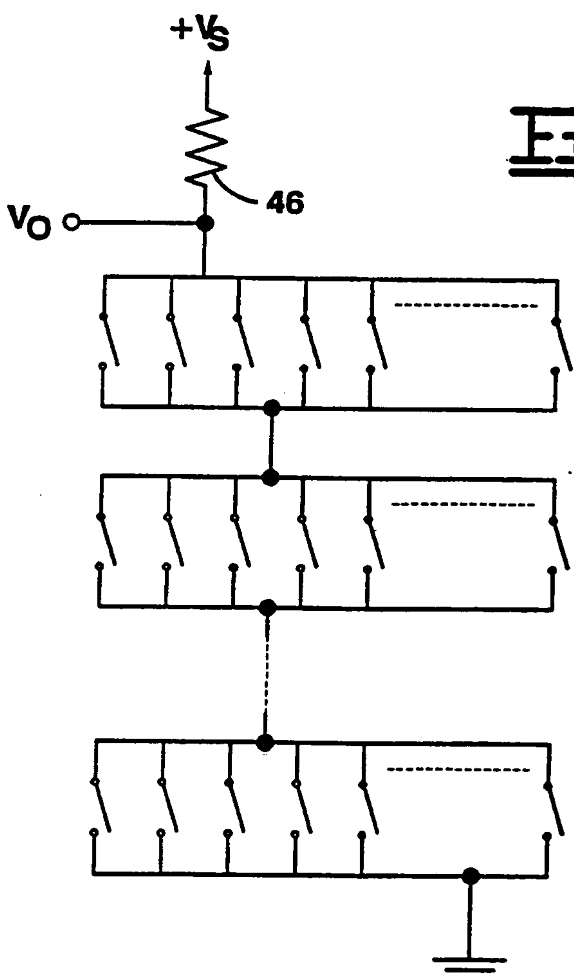


FIG. 6B

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 91/09464

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 F01N3/02

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	F01N

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
X	DE,A,3 608 801 (FEV) 17 September 1987 see column 3, line 31 - column 4, line 50 see column 5, line 54 - line 61; figures 1-4 ---	1-3,6, 8-10,13, 15-19
X A	US,A,4 656 832 (YUKIHISA) 14 April 1987 see column 4, line 37 - line 52 see column 5, line 59 - column 12, line 52; claims 1-4; figures 1-15 ---	1-4,6, 8-11,13, 15-19 7,14
X	PATENT ABSTRACTS OF JAPAN vol. 7, no. 183 (M-235)12 August 1983 & JP,A,58 085 315 (TOYO KOGYO) 21 May 1983 see abstract --- -/--	1-4, 9-11,16, 18

° Special categories of cited documents : [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
21 APRIL 1992	14.05.92
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	FRIDEN C.M. C Friden

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International Application No PCT/US 91/09464

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 7, no. 259 (C-195)18 November 1983 & JP,A,58 143 816 (MATSUSHITA DENKI SANGYO) 26 August 1983 see abstract	1-3,9, 10,16,18
A	US,A,4 522 027 (HASEGAWA) 11 June 1985 see column 11, line 27 - column 12, line 5	5,12
A	US,A,4 829 766 (HENKEL) 16 May 1989 cited in the application see column 6, line 32 - line 35; figure 6	7,14
A	US,A,4 283 207 (MARTYNIUK) 11 August 1981	

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. US 9109464 SA 55292

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 21/04/92
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		JP-A-	59060018	05-04-84
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US-A-4283207	11-08-81	None		

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82